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Variations in Weapons Instruction: A Case Study of Dragon Gunnery

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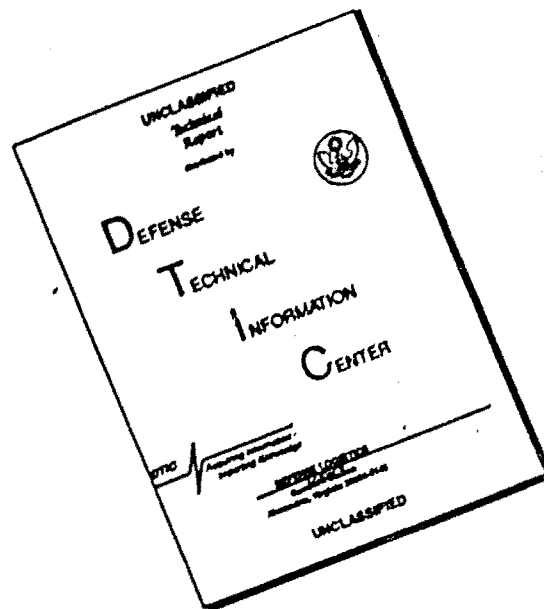
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VARIATIONS IN WEAPONS TRAINING: A CASE STUDY OF DRAGON GUNNERY

EXECUTIVE SUMMARY

Requirement:

To document the training resources and instructional procedures used in institutional and unit training on the Dragon weapon system, and to compare these resources and methods to military guidelines for Dragon training.

Procedure:

Army and Marine Corps institutional Dragon training, and Army nonmechanized and mechanized unit Dragon training were observed. Formal observations were made of instructional content, instructional techniques, time spent on each block of instruction, down time, and training aids and devices. Student performance (times and errors), test scores, type of tests administered, and test standards were also recorded. The quality of instruction was evaluated from an instructional design perspective and in terms of the extent to which the training process addressed the gunner requirements.

Findings:

Of the 12 training objectives cited in Army guidelines, nine were taught at all sites. Comparisons of instructional time devoted to each Dragon training objective, total training time, training resources, and testing procedures showed relatively little commonality across sites. The highest degree of commonality occurred when either the tactical equipment or a training device was necessary for task performance.

Utilization of Findings:

The results of the observations provided a foundation for the projected resource requirements for the advanced antitank weapon system-medium (AAWS-M), the replacement system for Dragon. They also showed the need to develop training aids, guides, and devices that increase standardization of instruction and testing of critical weapon skills. Recommendations for improving training based on principles of instructional design were made.

VARIATIONS IN WEAPONS TRAINING: A CASE STUDY OF DRAGON GUNNERY

CONTENTS

	Page
INTRODUCTION	1
Army Guidelines: Institution	2
Army Guidelines: Unit	4
Research Objective	5
METHODS	5
RESULTS	6
DISCUSSION	19
CONCLUSIONS	20
REFERENCES	21
APPENDIX A. PERIODS OF INSTRUCTION, CONTENT, AND TIME (HOURS) IN TC 23-24 C1	A-1
B. PERIODS OF INSTRUCTION, CONTENT, AND TIME (HOURS) IN FC 23-24	B-1
C. EXAMPLE OF A FIRING TABLE FOR THE DRAGON ..	C-1
D. OBSERVATION FORM	D-1

LIST OF TABLES

Table 1. Instructor and student data by site	7
2. Allocation of training time by site	7
3. Comparison of training time (minutes) by objective and site	9
4. Instructional procedures by site	11
5. Testing procedures by site	14

VARIATIONS IN WEAPONS TRAINING: A CASE STUDY OF DRAGON GUNNERY

Introduction

Estimating the impact a new system will have on training requirements and resources is difficult, particularly during early stages of system development. However, given that many new systems are evolutionary in nature, rather than revolutionary, information on the predecessor system can be extremely useful in lowering the risk when making such training estimates. In addition, the better the data on the predecessor, the better the estimate. The findings presented in this report on the Dragon were used to estimate the training requirements for its replacement, called the advanced antitank weapon system-medium (AAWS-M) (Dyer, Lucariello, & Heller, 1988). This report also documents the consistencies and differences in Dragon training in different settings, thus providing insights into the difficulties of standardizing training on a weapon system.

The Dragon is a one-man portable, medium-range, shoulder-launched, guided antitank missile. It is used by both the Army and the Marine Corps. The AAWS-M is also required to be one-man portable, medium-range, and to be shoulder-fired by the same population of soldiers and marines. Given these commonalities, information on Dragon training was considered essential in estimating the training impact of the AAWS-M.

Despite many investigations of Dragon training (e.g., Directorate of Evaluation, 1978; Klein, 1985; Smillie & Chitwood, 1986; Swezey, Chitwood, Easley, & Waite, 1985), there is a dearth of information on what actually occurs, and what has occurred historically during Dragon training. These previous investigations have been literature reviews of programs of instruction (POI), field manuals (FM), field circulars (FC) and training circulars (TC) describing proposed courses of instruction, or questionnaire analyses based on subject matter expert (SME) responses. Conclusions and recommendations from these reports were based on what was outlined in the training documents as the current practice rather than on observations of what was taught and how it was taught. Although, many of the conclusions and recommendations from these studies reflected valid issues (e.g., more combat-like training scenarios, more firing of inert rounds), the impact of the recommendations on actual Dragon instructional practices was not examined. Several reports (e.g., Cartner, Chiorini, & Chitwood, 1978; Combat Developments Experimentation Command (CDEC), 1979) did investigate Dragon training effectiveness. However, these studies were not based on actual, ongoing instruction, but used the formal POIs or developed a special curriculum. Data on how these curricula were implemented were limited.

A unique aspect of the AAWS-M training impact analysis (Dyer et al., 1988) was the formal observation of Dragon institutional and unit training within the Army and the Marine Corps. Understanding exactly what occurred in Dragon training, the materials used, the relationship between training standards and combat standards, the effectiveness with which training devices were used, and the quality of the instruction was critical in determining the extent to which these procedures would be effective with the AAWS-M and the extent to which the gunners would achieve the desired levels of proficiency.

Army Guidelines: Institution

Army guidelines for Dragon training have changed over time as reflected in Army publications and institutional POIs. The training philosophies reflected by these guidelines provide a setting for understanding the training implications stressed in this report.

Training Publications. The initial training publication for the Dragon was TC 23-24 (Department of the Army (DA), 1974). This was modified by change 1 (C1) in 1976. According to Cartner et al. (1978), this POI was suggested by McDonnell Douglas Astronautics Company, the designer and manufacturer of the Dragon. An outline of the POI in TC 23-24 C1 is in Appendix A.

As stated in TC 23-24, the purpose of the Dragon training program was to qualify individual Dragon gunners, to develop and maintain the Dragon gunner's proficiency, and to train Dragon gunners in the engagement of multiple armor targets to match the weapon's capability. Intermediate training objectives related to gunner preparation and proficiency training were: inspect the weapon system, place the system into operation, inspect the training equipment, place the training equipment into operation, and perform operator maintenance on the training equipment.

A total of 34.5 hours of instruction was recommended over four days, with an additional hour for graduation on a fifth day. Small group (1 instructor to 4 students), hands-on, performance-oriented training was the guideline. It was recommended that the program not be compressed to less than four days, and was suggested that training occur over an eight day, half-day schedule. Furthermore, no more than 30 firings with the launch effects trainer (LET) were to be performed per half day of training, except during qualification. A total of 125 LET firings with the M64 grenade cartridge was required during practice.

Gunners were graded on the number of hits with the LET in each of three qualification tables. Each table consisted of 20 trials from either the sitting, kneeling, or standing supported position. Qualification requirements were 43 hits (above 70%) out of a total of 60, with at least 14 hits or more in each qualification table. The qualification ratings were:

Expert.	57 to 60 hits
1st Class Gunner.	51 to 56 hits
2nd Class Gunner.	43 to 50 hits
Unqualified.	42 and below

TC 23-24 stated that for moving targets, one half were to be engaged when moving from left to right and the other half were to be engaged when moving from right to left. Target speed was varied at 5, 10, and 25 miles per hour, target range was either 250 or 450 meters, and the range setting on the monitor was 2, 5, or 10 seconds of tracking time. As explained by Swezey, et al. (1985) the varied tracking time, speed and distance translate into simulated distances of 200, 500, and 1000 meters and speeds of 11.2 and 20.0 miles per hour. The one factor not varied in this speed/distance manipulation was

the size of the target. Obviously, at extended distances, the target in real life would be smaller than a near target.

Approximately ten years later FC 23-24 was published (DA, 1985a) to resolve conflicts between other documents and TC 23-24. Between publication of the two documents the AN/TAS-5 (Dragon night tracker) was introduced into the Army system, and was included in the FC. FC 23-24 is in effect at the present time.

In FC 23-24 the Dragon training program is designed for an eight-day course of instruction with a total of 60 training hours progressing from technical to tactical training. Additionally, no more than 20 LET rounds (versus 30 LET rounds in TC 23-24) are to be fired on each training day to avoid the fatigue and other negative performance effects of massed practice with the LET. The training objectives are more specific than outlined in the TC. Twelve training objectives are cited:

- Conduct a preoperational inspection of the Dragon tracker and round of ammunition;
- Prepare a Dragon for firing;
- Demonstrate correct Dragon firing positions;
- Perform immediate-action procedures for a Dragon misfire;
- Identify armored vehicles;
- Determine if a target is engageable;
- Construct a Dragon fighting position;
- Prepare a Dragon antiarmor range card;
- Perform emergency decontamination procedures on a Dragon;
- Perform emergency destruction procedures on a Dragon;
- Conduct a preoperational inspection of the AN/TAS-5 (night tracker); and
- Qualify with the Dragon weapon.

These objectives differ from TC 23-24 as do the suggested course outline and times (see Appendix B).

A total of 80 practice trials with the LET is required. Qualification requirements are 32 hits (80%) from a total of 40 firings with at least 16 hits in each of two qualification tables representing the sitting and standing supported positions.

One Station Unit Training (OSUT) POIs. The 1986 Infantry OSUT POI (US Army Infantry School & Center (USAISC), 1986) was in effect during the conduct of this research. The 1988 POI (USAISC, 1988) is the current POI.

The 1986 OSUT POI for the Dragon was a 40-hour block of instruction. The training objectives were the same as FC 23-24, except the inspection of the Dragon night tracker was not included, making a total of 11 tasks/objectives. Specific instructional times by objective were not indicated. A live-fire demonstration of a Dragon firing was included.

To graduate from the Dragon course the student had to score at least 8 of 10 hits from both the sitting and standing supported positions. In addition, the student had to

pass the end-of-course evaluation, which consisted of performance tests on the other ten Dragon tasks/objectives. A student was to be considered for elimination from training if the performance test was not passed after three attempts.

With the current OSUT POI (USAISC, 1988), gunner training is designed to be the first five days of a ten-day Dragon training program. Additional training is subsumed in a 120-hour field training exercise (FTX). Several content changes were made in the 1988 POI. First, the total number of tasks was reduced from 11 to 9. The tasks of perform emergency decontamination and perform emergency destruction were eliminated. Second, the gunner must now recognize friendly and threat armor vehicles using thermal imagery. A third change was in the end-of-block evaluation at the end of the initial 40 hours. The student is evaluated on five tasks only: Dragon qualification, conducting a preoperational inspection of the Dragon tracker and round of ammunition, demonstrating correct firing positions, performing immediate action procedures for a misfire, and recognizing friendly and threat armored vehicles. Practical exercises on range card are scheduled during the FTX, and any retesting is done during the FTX. Finally, the end-of-course OSUT test for the Dragon gunner includes three Dragon tasks: prepare a Dragon for firing, determine if a target is engageable, and prepare an antiarmor range card.

Army Guidelines: Unit

Unit training is typically the integration of skills soldiers learn during common task training and military occupational specialty (MOS) training. Sustainment training is maintaining an acceptable level of performance every day of the year rather than peaking for a given event. Frequently, Dragon gunner training in Army units must be more than sustainment, because initial gunnery training may also be required. When a unit receives Dragon training, soldiers who do not have their C2 Dragon gunner additional skill identifier (ASI) may be included in order to man empty Dragon positions. If the non-C2 ASI soldiers successfully complete the training, they are awarded a C2 ASI.

Once a Dragon gunner has been trained, the gunner in the unit should receive sustainment training monthly (DA, 1976; DA, 1985a). It is expected that the gunner will lose 25% accuracy if sustainment training is not conducted regularly. Sharp decrements in performance after delays in training can occur, as evidenced when testing was halted and refresher training was necessary during two operational tests of the Dragon (U.S. Army Infantry Board, 1978; U.S. Army Operational Test and Evaluation Agency, 1978).

According to TC 23-24 (DA, 1976) the gunner, at a minimum, was to fire the LET familiarization table 1 (see Appendix A) and instructional firing table III without the M64 grenade cartridge (dry fire) on a monthly basis. On a quarterly basis, three LET instructional tables (IV, V, and VI) with the M64 cartridge were to be fired as well as a performance examination administered. To qualify Dragon gunners, the three qualification firing tables and the multiple target engagement exercise were required. An example of a firing table is at Appendix C. If a gunner did not qualify in two successive quarters, the gunner was to be replaced. Additionally, it was recommended

that during Dragon gunner qualification, if the gunner failed to qualify, another attempt was allowed. Gunner confidence in the weapon was to be instilled by completing the advanced field tracking exercises on a semi-annual basis. Annually, the gunner should also prepare for the Army Training and Evaluation Program (ARTEP). To train new gunners in the unit, the basic Dragon gunner qualification course was required.

The current FC 23-24 (DA, 1985a) recommends units follow a 15-period gunner qualification program (see Appendix B) reflecting the same objectives described previously under institutional training. However, when time and equipment do not allow eight consecutive days of training, four periods of instruction can be eliminated (Period 4 - Instructional fire; Period 8 - Field firing; Period 9 - Performance test review/practice; Period 15 - Day and night advanced field tracking). Instructional fire should be reinstated if the gunners have difficulty in qualifying.

Research Objective

The primary purpose of the research was to document the training resources and instructional methods used to train Dragon gunners in different locations. Institutional and unit training at different sites was observed to obtain an estimate of consistency in Dragon training. Finally, tasks trained, training procedures, and test standards were compared to the current Army guidelines in FC 23-24.

Method

Both institutional and unit training of Dragon gunners was observed. The unit training was not sustainment, but rather training of new individuals to be Dragon gunners for vacated positions. In addition, both Army and Marine Corps training was observed. Four training programs, each at a different site, were observed in their entirety. However, because each program was observed only once, continuity of training was not examined. Another limitation of the observations was the inability to observe field training exercises within units. Thus the results pertain only to the initial training of Dragon gunners in institutions and units. It must be noted that the observations were limited to formal periods of instruction, and therefore did not include additional practice which could have occurred during off-hours.

Two to three observers were present at each site. The observers were as unobtrusive as possible; they did not interfere with or attempt to change the instructional process. When instruction occurred in small groups, each observer was assigned to a specific group of students and followed that group through training. Observers attended all training sessions and took notes while instruction was in progress. The observation system combined aspects of descriptive and narrative systems (Evertson & Green, 1986). Descriptive systems have predetermined categories for coding behavior which are then applied to audio/video records or a transcript of the event. In narrative systems events are recorded as they unfold in either written or oral form. The observation form used is in Appendix D. A form for recording testing procedures was also developed during the research, but was not used at all sites. It is also included in Appendix D. When available, POIs and test materials were collected for future reference.

Observers recorded the following information:

Background data on the instructional setting and the modes of instruction and testing.

Sequence of events, included starting and ending times. An event refers to a block of instruction (and testing) as defined by the instructor. However, when blocks of instruction lasted for more than 10 or 15 minutes, the observer also recorded the times when logical changes occurred in instructional content. The amount of and reasons for noninstructional or "down" time were recorded as well (e.g., formal breaks, loss of training time because of equipment problems, failure of students to arrive on time, transportation to secondary training areas).

The instructional content, purpose of the lesson, and all supporting training materials and devices were documented.

Individual student performance (e.g., number of training trials, go/no go results, number and type of errors made, time per trial) during training was recorded.

When testing occurred, observers recorded the test directions, the type of test, test procedures, correspondence between test and course objectives, scoring criteria, whether tests assessed gunner ability to transfer skills, actual and scheduled testing times, and test results.

The field notes were then converted into permanent records which provided a running log of the observations, and data summaries were generated as required.

Results

In general, the numbers of students and instructors were relatively similar across the four sites (Table 1). Instructor experience in firing Dragon missiles varied, however.

The total times allocated for Dragon training varied by site. Table 2 contrasts the total time scheduled for training to that actually observed. Scheduled time, by definition, includes noninstructional time, and is summarized in terms of both hours and minutes. Hours are a common way of presenting training times; minutes provide the appropriate comparison to times recorded during the training observations. It should be noted that class size was below the norm of 40 students for Site 1. Training time would increase with a full class, if training were conducted in the same manner with the same number of instructors.

Table 1

Instructor and Student Data by Site

Variable	Site 1	Site 2	Site 3	Site 4
# Students	27	33	35	32
# Instructors	8	7 ^a	7	9
Average Months as Instructor	13	NA	NA	15
# Instructors fired Missile	5	2	NA	8
Average # Missiles Fired	<1	<1	NA	6

Note. NA = not available.

^a Five were assistant instructors.

Table 2

Allocation of Training Time by Site

Time	Site 1	Site 2	Site 3	Site 4
Scheduled Time				
Hours	40	44	32	46
Minutes	2400	2640	1920	2760
Actual Time (Min)				
Instruction	972 (56%)	860 (40%)	451 (38%)	1267 (66%)
Testing ^a	409 (24%)	346 (16%)	409 (34%)	228 (12%)
Noninstructional	357 (20%)	926 (44%)	338 (28%)	439 (22%)
Total	1738	2132	1198	1934
Ratio of Actual to Scheduled Time ^b	.72	.81	.62	.70

^a Includes both LET qualification and proficiency testing on other tasks.

^b Ratio based on minutes scheduled.

At each site, the actual time in classrooms and on the range, including the noninstructional down time, was less than that in the course outline for each site. The ratio of actual to schedule time ranged from .62 (Site 3) to .81 (Site 2). The distribution of time among the categories of instruction, testing, and down time cited in Table 2 varied. The proportion of time devoted to instruction was greatest at Site 4 (66%) and lowest at Site 3 (38%). The proportion of time devoted to student testing was the greatest at Site 3 (34%) and the lowest at Site 4 (12%). The greatest percentage of down time was 44% at Site 2. This high percentage resulted from training equipment problems; either the LETs or the monitoring sets at each firing station malfunctioned.

The Dragon tasks and skills taught at each site also varied, although considerable overlap did occur. Of the twelve training objectives cited in FC 23-24, nine were taught at every site. Not common to all sites was training on identification of targets, emergency destruction, and decontamination. Instruction on training equipment, stressed in the original TC 23-24, occurred at Sites 1 and 4 only.

Time allocated to the common tasks/objectives varied (Table 3). Some of the greatest differences occurred on maintenance and engagement of targets. Only training at Site 1 covered fully the inspection and operation of the night tracker. Although all training included large portions of time devoted to LET firing, each student received the most amount of time on the LET at Site 1. The average time on the LET for students at Site 1 was over twice the time spent by students at the other sites. Time devoted to target engageability at Site 4 was high because this block of instruction also focused on using the tracker to evaluate the type of target being engaged and to estimate the range to specific targets. At Site 2 large blocks of instruction regarding target engagement focused on target identification and gunner employment of antiarmor systems.

The times in Table 3 must be interpreted in conjunction with the mode and focus of the instruction. As would be expected, the facilities at each site differed and influenced the mode of instruction.

At Site 1, the instruction typically occurred in bleachers for large group instruction (27 students to 1 instructor), in the open around a training area for small group instruction (3 to 6 students to 1 instructor), and on a covered firing line for one-on-one instruction. Six blocks of instruction were taught in a large group: introduction to the Dragon, range procedures and safety, antiarmor range card, target engageability, construct a fighting position, and live-fire demonstration. All other instruction was done in small groups of three to six students to one instructor. When students fired the LET and the LES (launch environment simulator), instructor to student ratio was one-to-one.

At Site 2 training occurred in different areas. Large group instruction was in a 30 person classroom. This was used for lectures and films on the Dragon weapon system, vehicle identification, antiarmor range card, and target engageability. The second training area was outside under a protected area. A round robin, small group format was used to present and test ten tasks and skills: the Dragon fighting position and decontamination, pre-operational inspection maintenance and prepare to fire, emergency

Table 3

Comparison of Training Time (minutes) by Objective and Site

Objective	Site 1	Site 2	Site 3	Site 4
MAINTENANCE				
Inspect Day Tracker/Round	60	5	53	48
Inspect Night Tracker	75	5	18	5
PREPARE FOR FIRING	45	10	30	20
ENGAGE TARGETS				
Engageability	45	46	15	146
Target Identification	--	224	91	192
Day Firing ^a	422 ^b	217	250	143
Night Firing ^c	45	36	--	75
Engagement/Employment ^d	45	225 ^e	10	27
FIGHTING POSITION	30	5	123	5
RANGE CARD	70	67	52	125
MISFIRE	40	5	10	21
DECONTAMINATE	--	6	--	--
DESTRUCTION	--	6	27	10
OTHER TRAINING				
General System Information	30	57	22	105
Team Drill	--	--	--	70
Maintain/Set-up LET	205	5	--	118
Maintain/Operate Target Board	--	--	--	127
Class Procedures, Live-fire demo	65	--	--	30
PROFICIENCY TESTS^f	204	287	159	228
TOTAL	1381	1206	860	1495

^a Includes qualification on the LET.^b Includes 15 minutes with protective mask.^c Night tracker firing during day and/or night and day tracker firing at night.^d Includes training on firing positions.^e Includes substantial information on anti-armor employment.^f Excludes LET qualification; includes testing and review on all other tasks and skills.

destruction and malfunctions, firing positions and antiarmor range card, and target engageability and vehicle ID. The third area was the LET and LES firing range. Students fired the LET and LES from a ridge overlooking an open range; individualized instruction was used.

At Site 3 all instruction was conducted in the open. Instruction on all tasks except LET firings was in round robin format with small groups of 7 to 12 students to one instructor. The instructor to student ratio was one-to-one for the LET firings. The LET firings were conducted on an old helicopter landing zone.

At Site 4 instruction was in a classroom, in the open overlooking a football field, and on the LET range. Most instruction was in the classroom, with different instructors assigned to teaching specific tasks and skills (e.g., prepare to fire, target identification, system maintenance). A football field was used for testing range estimation and engageability, and training range card procedures. The student to instructor ratio on the LET was one-to-one, the same as all other sites.

Further information on the instruction for each task and skill at each site is in Table 4. The size of the group taught by each instructor, the amount of practice required of each student, and the training equipment and materials used for each block of instruction are presented. Variations by site are apparent. The number of practice trials per student varied across tasks as well as within tasks. The guidance in effect at the time of the research called for 80 LET practice trials (FC 23-24, initially 125 LET firings were required by TC 23-24). Training at Site 1 approached this criterion with 58 LET and 2 LES trials per student. At the other sites the maximum number of trials ranged from 8 to 30.

No specific guidance regarding the number of practice trials existed in the literature for the other Dragon tasks. In actuality, few trials occurred. When no practice trials occurred, the instructors relied on a demonstration to teach the task. LET instruction, target engageability, target identification, range cards, and misfire procedures were the only training objectives where students had more than one practice trial.

Where task performance required Dragon equipment/training devices, they were used, and provided some standardization of instruction (e.g., inspection of the day and night trackers, prepare for firing). Training equipment was the same for LET instruction. At all sites the target moved at a constant speed along a relatively flat surface in an unobstructed environment. However, the exact target vehicle speed and tracking time varied across units. For many other training objectives, training aids were unique to the site. The instructors used self-developed aids and/or any other training aid available through normal military channels (e.g., flash cards for target identification from the Army's graphic training aid 17-2-13, training extension course (TEC) tapes, films, miniaturized vehicle models) appropriate to the training environment.

Table 5 summarizes the testing procedures and standards by site and the standard in FC 23-24. No site tested all training objectives. Taken as a whole, the testing procedures at each site never matched those in FC 23-24 and the supporting 11B soldier's manual (DA, 1985b). Test procedures for some individual tasks were identical

Table 4

Instructional Procedures by Site

Training Objective	Site	LG/SG/ 1 on 1 ^a	Practice	# Trials/ Student	Equipment
SYSTEM MAINTENANCE					
Inspect Day Tracker/Round	1	SG	Yes	1	Day tracker, field handling trainer (FHT)
	2	SG	No	--	Day tracker, LET, Poster with steps
	3	SG	Yes	1 ^b	Day tracker, FHT
	4	LG	No	--	Day tracker, FHT, cleaning kit, view graphs
Inspect/Operate Night Tracker	1	SG	Yes	1	Night tracker, battery and coolant bottles
	2	SG	No	--	Night tracker
	3	SG	Yes	1	Night tracker
	4	LG	No	--	Night tracker, battery, coolant bottles, ruck sack, view graphs
PREPARE FOR FIRING	1	SG	Yes	1	Day tracker, FHT, carry bag
	2	LG	No	--	Video tape on task steps
		SG	No	--	Poster with steps, day tracker, LET
	3	SG	Yes	1 ^b	Day tracker, FHT
	4	LG	No	1	Day tracker, FHT, carry bag, view graphs
ENGAGE TARGETS					
Engageability	1	LG	No	--	Photos of targets, plexi-glass circle with stadia
		SG	Yes	3-4	Day tracker, FHT, miniaturized range with scaled vehicles/obstacles
	2	LG	No	--	Chalkboard, video tape
		SG	No	--	Poster, sand drawing of reticle
	3	SG	Yes	Group Response	Picture of targets
	4	LG	Yes		Distance estimation stressed. View graphs of targets & overlay with metric marks on stadia.

Training Objective	Site	LG/SG/ 1 on 1 ^a	Practice	# Trials/ Student	Equipment
Target Identification (ID) ^c	1	--	--	--	--
	2	LG	Yes	2-3	Films, view graphs of vehicles
		SG	Yes	1	Poster with vehicles, scaled vehicle models
	3	SG	Yes	1	Flash cards with line drawings of vehicles
	4	LG	Yes	2-3	Video tape, view graphs, written and verbal quizzes
LET Firing	1	1 on 1	Yes	48	LET with day tracker & target vehicle
				5	Protective mask firing
				5	LET with night tracker, smoke, & target vehicle during day
				2	LES with day tracker
	2	1 on 1	Yes	25-30	LET with day tracker & target vehicle. Night tracker night trials & LES trials stopped due to equipment problems
	3	1 on 1	Yes	1-8	LET with day tracker & target vehicle
	4	1 on 1	Yes	15	LET with day tracker & target vehicle
				4	LET with night tracker at night & target vehicle
Firing Positions	1	1 on 1	Yes	--	Part of LET instruction
	2	LG	No	--	Video tape; practice included in LET firing
		SG	No	--	Pictures of positions
	3	SG	Yes	1 ^b	Day tracker, FHT
	4	LG	No	--	Day tracker, FHT
FIGHTING POSITION	1	LG	No	--	Chalkboard, preconstructed position
	2	SG	No	--	Poster with position dimensions
	3	SG	Yes	1	Poster with position dimensions; student drew fighting position
	4	LG	No	--	No visual aids/equipment

Table 4 continued

Training Objective	Site	LG/SG/ 1 on 1 ^a	Practice	# Trials/ Student	Equipment
RANGE CARD	1	LG	Yes	1-2	Chalkboard, hypothetical defensive position
	2	LG	Yes	1	Chalkboard, video tape, range card completed after class
		SG	No	--	Sand table to illustrate critical elements of card
	3	SG	Yes	1 ^b	Poster board with task standards; sample range card; students generated own range card data
	4	LG	Yes	1	View graphs, range card constructed using actual terrain
MISFIRE	1	SG	Yes	1-2	Day tracker, FHT
	2	SG	No	--	Poster with steps
	3	SG	Yes	1	Day tracker, FHT
	4	LG	No	--	Day tracker, FHT
DE-CONTAMINATE	1	--	--	--	---
	2	SG	No	--	Poster with steps
	3	--	--	--	---
	4	--	--	--	---
DESTRUCTION	1	--	--	--	---
	2	SG	No	--	No visual aids/equipment
	3	SG	No	--	Poster with standards, also instances with no aids
	4	LG	No	--	No visual aids/equipment

Note. When equipment is listed but students did not practice, the instructor used the equipment for demonstration purposes only. At sites 1 and 4 students also had hand-outs covering all tasks.

^a LG = Large group (all students or half the class); SG = Small group (12 students or less, typically less than 7); 1 on 1 = Individual instruction.

^b Varied with small group; not all students practiced.

^c Number of practice trials on target ID represents number of times each student had to identify a series of targets (typically 10 or more), not the total number of target identified.

Table 5

Testing Procedures by Site

Training Objective	Site/FC	Test Description	Criteria
SYSTEM MAINTENANCE			
Inspect Day Tracker/Round	1	Verbal description of steps using equipment	No errors, 2 retests
	2	Verbal response to 4 questions	No errors, 1 retest
	3	Verbal description of steps using equipment	5 minutes with no errors
	4	Items on final written exam	70% to pass exam
	FC	Describe steps using equipment; conduct inspection	5 minutes with no errors, 1 retest
Inspect Night Tracker	1	Verbal description of steps using equipment	No errors, 2 retests
	2	Not tested	- - -
	3	Verbal description of steps using equipment	5 minutes with no errors, time limit not enforced
	4	Items on final written exam	70% to pass exam
	FC	Describe steps using equipment; conduct inspection	5 minutes with no errors, 1 retest
PREPARE FOR FIRING	1	Hands-on test	No errors, 2 retests
	2	Items on written test	70% to pass test
		Hands-on test	No errors, 1 retest
	3	Hands-on test	1 minute with no errors
	4	Not tested	- - -
	FC	Hands-on test	1 minute with no errors, 1 retest

Table 5 continued

Training Objective	Site/FC	Test Description	Criteria
ENGAGE TARGETS			
LET Qualification	1	Qualify - 10 shots sitting, 10 shots standing supported, varied target speed & tracking time	8 hits (80%) from each position
		Gunner rating - 50 rounds	Expert: 45 hits First class: 40 hits
	2	Special tables, sitting & standing supported; most gunners qualified with 24 dry fire trials	Varied with tester due to LET problems
	3	20 shots sitting, constant target speed of 5 mph, target tracking time varied with tester	16 hits (80%)
	4	Not required in course; unit qualification; 60 shots, 20 from each of 3 firing positions	14 hits (70%) from each position
	FC	20 shots sitting, 20 shots standing supported, vary target speed and tracking time	16 hits (80%) from each position
Engageability	1	4 scaled targets on scaled terrain	No errors, 2 retests
	2	Verbal response to 5 questions	No errors, 1 retest
	3	4 scaled targets on scaled terrain	Varied with tester; 75-100% to pass, 1 retest
	4	4 scaled targets on scaled terrain, distance estimation also required	No errors, 1 retest
	FC	At least 3 1:35 scaled targets on scaled terrain at 14 to 43 meters OR view graphs	10 seconds for each target with no errors, 1 retest

Table 5 continued

Training Objective	Site/FC	Test Description	Criteria
Target ID	1	Not tested	- - -
	2	Written test with line drawings of vehicles, ID by nomenclature & country	70% to pass
		Verbal test of correct vehicle nomenclature & country using scaled vehicles on terrain.	No errors, 1 retest
	3	Pictures of 10 vehicles	Varied with tester; 80-100% correct as friend or threat & 70-80% correct by nomenclature, 10 seconds per vehicle, 1 retest
	4	13-vehicle, scaled-model, multiple-choice test	70% to pass
	FC	Pictures or models of 10 armored vehicles; 4 friendly and 6 threat	2 minutes with 80% correct as friend or threat & 70% correct by nomenclature; 1 retest
Firing Position	1	Graded during LET qualification, sitting and standing supported positions	Varied with tester
	2	Written test with pictures of firing positions	70% to pass
		Verbally named firing positions	No errors, 1 retest
	3	Hands-on demonstration, sitting position	30 seconds with no errors
	4	Not tested	- - -
	FC	Hands-on demonstration, sitting position	30 seconds with no errors; 1 retest

Table 5 continued

Training Objective	Site/FC	Test Description	Criteria
FIGHTING	1	Not tested	- - -
POSITION	2	Verbal description of major parts	No errors, 1 retest
	3	Written test, draw a fighting position, indicate dimensions	10-12 minutes with no errors, time limit not enforced, 1 retest
	4	Items on final written exam	70% to pass exam
	FC	Diagram fighting position with proper dimensions	10 minutes with no errors, 1 retest
RANGE CARD	1	Construct 1 card with data from tester	2 errors, 2 retests
	2	Verbally named 4 of 8 elements on card	No errors, 1 retest
	3	Construct 1 card from self-generated data	10 minutes with no errors, 1 retest
	4	Items on final written exam	70% to pass exam
	FC	Construct range card in field environment	10 minutes with no errors, 1 retest
MISFIRE	1	Hands-on simulation & verbal description of reactions to malfunctions	No errors, 2 retests
	2	Verbal response to specific malfunctions	No errors, 1 retest
	3	Hands-on simulation & verbal description of reactions to malfunctions	No errors, time varied with tester - 1 minute or no time limit
	4	Items on final written exam	70% to pass exam
	FC	Hands-on simulation & verbal description of reactions to malfunctions	1 minute with no errors, 1 retest

Table 5 continued

Training Objective	Site/FC	Test Description	Criteria
DE- CONTAMINATE	1	Not tested	- - -
	2	Verbal description of procedures	No errors, 1 retest
	3	Not tested	- - -
	4	Not tested	- - -
	FC	Verbal description of procedures for chemical, radiological or biological situation; decontamination check	5 minutes with no errors, 1 retest
DESTRUCTION	1	Not tested	- - -
	2	Verbal response to selected emergency destruction conditions	No errors , 1 retest
	3	Test varied with tester. Verbal description of procedure OR Answer 4 questions on emergency destruction	1 minute with no errors 1 minute with no errors
	4	Not tested	- - -
	FC	Verbal description of procedure	1 minute with no errors, 1 retest

Note. Site 2 - System employment, selection of firing positions, and system characteristics covered in written test during course. Final exam of 34 items.
Site 4 - Final exam of 50 items.

and some varied only slightly (e.g., Sites 1, 2, and 3 were similar on prepare for firing and malfunctions; Sites 1 and 3 similar on system maintenance). In some cases, the change in test procedures meant that different skills and knowledge were required. For example, actual construction of range cards with instructor data is more demanding than naming four of the eight elements on the cards. Construction requires the student know all parts as well as how to fill-in the card properly. LET qualification procedures are made easier when the student fires from a single position, under dry-fire conditions, and/or at targets moving at a constant speed. Hands-on tests demand the ability to manipulate equipment and react to mistakes in handling it as well as knowledge of procedures and equipment parts. Written tests examine only the latter skills. In essence, the variations in test procedures meant the performance standard was more difficult at some sites than at others.

Discussion

When Dragon training is viewed from learning theory and instructional design perspectives, some changes are needed to facilitate the learning process. Gagne's (1977) learning phases and instructional events are used to illustrate strengths in Dragon training and potential training changes which could minimize perceived weaknesses. Gagne's motivation phase, characterized by activating motivation and stating the training objective, is usually completed successfully during military training. The instructor must next ensure the student is ready to apprehend the material. The military generally ensures students are in an attentive posture. However, instructors need to improve the process of directing student's attention to facilitate short term memory. For example, the step of remembering to remove the imaginary electrical connector cover from the Dragon round when mounting the tracker resulted in many errors. If the instructor had stated this step first, stressed that it is commonly missed, and then presented it within the context of the task as well, the step would have been emphasized and the student's attention would have been directed to a potential problem.

During acquisition of tasks, instructors need to stress an encoding strategy, a means to help students code or process new information. In the prepare for firing example, if the instructor provides a strategy to remove the tracker electrical connector and then immediately removes the imaginary electrical connector cover on the round, a strategy for encoding and recall has been provided. The step is no longer just another step of the total task. Additionally, this strategy helps generalization of learning by reminding the student that the electrical connector must be checked during the preoperational inspection and must be returned when restoring the round to a carry configuration. Obviously, the more this is practiced, with an instructor providing feedback, the more easily the student will perform the task correctly when required.

LET training provides another example of how instruction could be modified to enhance skills. During all the training observed, the target vehicle moved at a constant speed, along a relatively flat surface, in an unobstructed environment. This type of engagement environment may facilitate the initial learning of engaging targets with the LET by providing a simple scenario. However, once the mechanics of firing the LET and engaging targets have been mastered, the learning environment should become more

complex to parallel a real-world situation. The LET and infrared (IR) target board were designed for evasive maneuvers, provided certain boresighting and maneuvering constraints are followed. Once students have learned the task, the vehicle driver should be instructed to move evasively. In addition, other factors such as mission-oriented protective posture (MOPP-4) should be incorporated in training and testing. Such training would promote transfer and generalization of learning (Gagne, 1977).

Typically, students were trained for the test. This was seen on written tests (e.g., antiarmor range card) as well as practical application (e.g., LET qualification). The student was rarely put in a position where knowledge had to be applied in a unique situation (a high level of learning); repetitively practiced tasks or situations were tested (a low level of learning).

The most significant weakness in Dragon training across all sites was the lack of thermal imagery training, and was highlighted as one to be resolved while developing training materials for the AAWS-M system (Dyer et al, 1988). LET training using the night tracker was minimal or non-existent, and no qualification tables were fired. In addition, the target identification blocks of instruction did not provide students with training on the dynamics of thermal imagery, and on how to detect and discriminate targets with this technology. This latter finding is critical since the LET provides the student with only a infrared "X" on the target board for tracking purposes, not the thermal image of a vehicle. The minimal training with the night tracker illustrates clearly how the lack of appropriate training devices and additional training materials influences the skills acquired on a weapon system. The situation is complicated further by the fact that instructors cannot modify the training device or easily develop additional materials to correct this deficiency.

Conclusions

The results indicate that standardization of instruction and testing is difficult to achieve. Training times, tasks/objectives, and materials differed. Despite these significant variations, commonality in training was most likely when the tactical equipment or a required training device was necessary for task performance. When such was not required, both the materials and the methods of instruction and testing varied. Greater consistency in training device use could occur if a trainer's guide were provided on how to use a device to achieve the performance standard. This guide would supplement the technical manual which covers the physical operation and maintenance of the device. Greater standardization of the total training program could be achieved by creating all the necessary training support materials during system development and then fielding these simultaneously with the tactical equipment.

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APPENDIX A

PERIODS OF INSTRUCTION, CONTENT AND TIME (HOURS) IN TC 23-24 C1

Day	Period	Content	Time
1	1	Introduction to the M47 Dragon (introduction to operation, firings positions, safety)	.5
	2	Introduction to the Dragon training equipment (infrared transmitter, monitoring set, launch effects trainer (LET), field handling trainer, tracker)	.5
	3	Practical exercise on training equipment (hands-on training)	1.0
	4	Familiarization table I (30 round table with LET, dry fire, 12 stationary and 18 moving targets)	2.5
	5	Operator maintenance and battery charging procedure with training equipment (conference and practical exercise with hands-on training)	1.0
	6	Instructional firing table II (30 round table with LET and M64 grenade cartridge, 12 stationary and 18 moving targets)	2.5
	7	Maintenance of training equipment	.5
2	1	Practical exercise on Dragon training equipment	.5
	2	Instructional firing table III (30 round table with LET and M64 grenade cartridge, 6 stationary and 24 moving targets)	2.0
	3	Introduction to tank identification and vulnerabilities (conference and practical exercise)	1.5
	4	Introduction to the M222 Dragon missile (conference, functioning, hangfire, misfire, safety)	.5
	5	Instructional firing table IV (sitting, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5

	6	Technique of fire (Practical exercise, two-man teams, prepare subsequent rounds for firing, using trackers and field handling trainers)	1.0
	7	Maintenance of training equipment	.5
3	1	Practical exercise on Dragon training equipment	.5
	2	Familiarization firing table VII (prone, 5 round table with LET and M64 grenade cartridge, stationary targets)	.5
	3	Instructional firing table V (kneeling, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5
	4	Instructional firing table VI (standing, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5
	5	Maintenance of training equipment	.5
	6	Dragon test (proficiency and written tests)	3.5
4	1	Practical exercise on Dragon training equipment	.5
	2	Qualification table VIII (sitting, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5
	3	Qualification table IX (standing supported, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5
	4	Maintenance of training equipment	.5
	5	Qualification table X (kneeling, 20 round table with LET and M64 grenade cartridge, moving targets)	1.5
	6	Day field tracking (tracking from armored personnel carrier (APC) and two-man separated foxhole, tracking from sitting and kneeling positions, Dragon range card, Dragon battle drill)	2.5
	7	Night field tracking (with illumination, introduction to night firing techniques, tracking from APC, foxhole, sitting and kneeling positions)	2.5
5		Graduation	1.0

APPENDIX B

PERIODS OF INSTRUCTION, CONTENT AND TIME (HOURS) IN FC 23-24

Period	Content	Time
1	Orientation on Dragon Weapon System (introduction to system and training equipment, firing positions with practical exercise)	4.0
2	Instructional Firing (sitting, 20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0
3	Orientation on Dragon Weapon System, Preoperational Inspection of Components, Emergency Decontamination and Destruction Procedures, Immediate Action	4.0
4	Instructional Firing (standing supported, 20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0
5	Tank Identification and Target Engageability	2.0
6	Field Firing (mixed positions, 20 rounds with LET and M64 grenade cartridge, or 15 rounds with LET and 10 LES end caps for 5 firings, stationary and moving targets) (Mandatory)	6.0
7	Construct Range Cards and Fighting Positions	4.0
8	Field Firing (mixed positions, 20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0
9	Performance Test Review/Practice	4.0
10	Dragon Qualification Firing (20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0
11	Performance Testing	4.0
12	Dragon Qualification (20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0
13	Orientation on Dragon Maintenance (system and training equipment)	4.0
14	Retest Performance Test/Refire Qualification (20 rounds with LET and M64 grenade cartridge, stationary and moving targets)	4.0

15	Day and Night Advanced Field Tracking (15 rounds with LET and M64 grenade cartridge, 10 LES caps for 5 rounds, battlefield conditions)	4.0
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APPENDIX C

EXAMPLE OF A FIRING TABLE FOR THE DRAGON

Round Sequence	# Rounds	Firing Position	Target Posture	Monitor Set Range Setting	Target Speed (mph)
1	2	Sitting	Moving	5	3
2	2	Kneeling	Moving	5	5
3	2	Kneeling	Moving	2	10
4	2	Kneeling	Moving	2	5
5	2	Standing	Stationary	10	0
6	2	Standing	Moving	10	5
7	2	Standing	Moving	2	10
8	5	Kneeling	Moving	10	3
9	5	Kneeling	Moving	10	5
10	6	Sitting	Moving	10	3

Note. Instructional firing table VII from TC 23-24. 30 engagements with M64 cartridge. Target range is 250 meters.

APPENDIX D

OBSERVATION FORM

DATE _____ TRAINING DAY [1st - nth] . DATA COLLECTOR _____

WEATHER CONDITIONS [Temperature, precipitation, humidity, etc.]

TASK/PERIOD [Task, skill, content, and/or activity; Instruction or Test.]

MODE OF INSTRUCTION

[Lecture, demonstration, hands-on practice, question-answer, one-on-one, test, ...]

INSTRUCTOR/STUDENT RATIO [1 to xx]

TOTAL INSTRUCTIONAL TIME [xx min]

START TIME[__:__] STOP TIME [__:__]

TIMES FOR SPECIFIC TOPICS [Summary of times cited under Instructional Record below. Includes breaks in training. Times sum to Total Instructional Time above.]

[Topic or Area #1]	START [__:__]	STOP [__:__]
[Topic or Area #2]	START [__:__]	STOP [__:__]
[Topic or Area #3]	START [__:__]	STOP [__:__]
[Topic or Area #4]	START [__:__]	STOP [__:__]
...		
[Topic or Area #n]	START [__:__]	STOP [__:__]

INSTRUCTIONAL RECORD

[Observer's record of instruction. Recorded in sequence by critical time segments; breaks recorded with reason for break cited. When lecture format, content presented was recorded. Details of instructor demonstrations recorded. . . .]

TRAINING DEVICES

[List of training devices; quantities of each device]

TRAINING AIDS

[List of training aids; e.g., Army films, TEC tapes, student handouts, visual aids of various types, models of threat and enemy vehicles, overhead projection equipment.]

STUDENT PERFORMANCE DATA *[Time and error data; Only recorded when hands-on practice or testing occurred.]*

			# Errors
S: [Student name/#]	ST[<u> </u> : <u> </u>]	STP [<u> </u> : <u> </u>]	<u> </u> Go/NoGo
S: [Student name/#]	ST[<u> </u> : <u> </u>]	STP [<u> </u> : <u> </u>]	<u> </u> Go/NoGo
S: [Student name/#]	ST[<u> </u> : <u> </u>]	STP [<u> </u> : <u> </u>]	<u> </u> Go/NoGo
S: [Student name/#]	ST[<u> </u> : <u> </u>]	STP [<u> </u> : <u> </u>]	<u> </u> Go/NoGo

TRAINING PROBLEMS

[Record of incidents that created training problems, e.g., equipment failures, ammunition not on time, poor lighting for film, poor quality videotapes.]

PREREQUISITE KNOWLEDGE AND SKILLS ASSUMED

[Skills and knowledge students needed to understand material presented or to perform the task.]

QUALITY OF INSTRUCTION

[Comments on training from an instructional design perspective; problems encountered by students in mastering materials; etc.]

OTHER NOTES/OBSERVATIONS

FOR TESTS ONLY

Proficiency Test administered immediately after instruction? Yes No

Proficiency Test: Written Hands-on None Other:

Proficiency Standards: Go/NoGo Numeric None Other:

[Additional information on tests such as test items, quality of instructor testing, equipment and aids used. Number of attempts allowed was also recorded.]

FORM FOR TEST PROCEDURES

TEST *[Name of task or skill tested]*

DESCRIPTION OF TEST PROCEDURE

[Details on test instructions, equipment used, sequence of events, type of test (written, hands-on, oral, etc.), whether test was group or individually administered,]

CRITERIA FOR PASSING

DID TEST CORRESPOND TO TRAINING OBJECTIVE? YES NO

If NO, describe discrepancies.

WERE TEST DIRECTIONS CLEAR, SIMPLE AND EASY TO FOLLOW? YES NO

WAS THE TEST DIFFERENT FROM THE PRACTICE AND/OR EXAMPLES DURING CLASS? YES NO

If YES, how did the test differ?

RESULTS OF TESTING

[List of test results by student - test time, score, Go/NoGo, # trials]

SUMMARY OF RESULTS

Time allocated per student _____

Min/max times for students _____/_____

Total testing time for class _____

Average time/student _____

Average score _____

Average number of errors per student _____

Types of errors *[List of types of errors and their frequency]*

Number of students who passed first time _____

Number of students who failed first time _____

Number of students who finally passed _____

Number of students who passed but required retests _____

Number of students who failed _____